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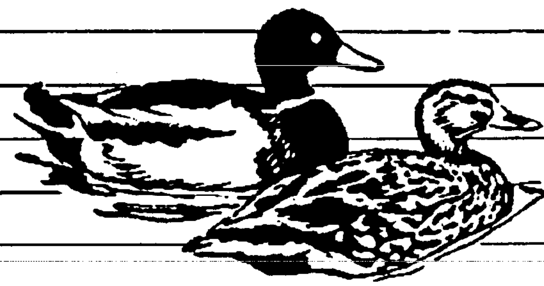

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Sonic Distance Device Improves Field Sampling Efficiency and Accuracy

Stem mapping is the process of recording plant location relative to a fixed origin on a defined coordinate system. Approaches to stem mapping differ in their level of precision depending on the equipment used. A study was conducted to determine the utility and accuracy of sonic distance devices for stem mapping forest research plots.

Two basic approaches commonly used to map forest stands are triangulation and polar sampling. Triangulation requires measured distances from two fixed points, whereas polar sampling involves the measure of a compass reading (azimuth) and distance from a single fixed point. Both methods require at least one distance measurement. The type and condition of equipment used can affect the quality of measurement. Cloth measuring tapes, for example, may stretch with time and abuse. Today, manufacturers offer a wide range of metal and fiberglass measuring tapes that remain stable and durable.

How a measurement is accomplished may be more important than what type or brand of instrument used. In a forest setting, there are always other trees that stand in the line of measurement requiring some compensation of measurement for the inevitable bend in the tape. The time-consuming tasks of unwrapping and rethreading the tape with each measurement is also a factor in achieving a straight line for accuracy.

In recent years, a wide array of electronic distance devices have become available. A sonic distance device was tested for accuracy and dependability for stem mapping a bottomland hardwood forest in coastal Louisiana.

Electronic Distance Devices

Electronic distance devices meet the public's need for wireless, tapeless distance-measuring capability. Realtors, construction crews, and survey teams are already using this technology in order to speed the process and improve the accuracy of measuring home and commercial layouts. Expensive survey equipment uses laser technology to achieve accurate measurement over long distances (i.e., 1,000 m). Other less costly devices are available, however, including sonic transmitters that bounce sound waves off flat surfaces. Manufactured units are also available that operate in dual mode with a transmitter and receiver using soundwaves and infrared light signals to measure open air distances.

Sonin, Inc., manufactures a sonic distance device designed to measure as far as 75 m under optimal conditions and costs less than $150 in forestry supply catalogs. We tested two units under ideal indoor conditions and under real field conditions. The unit proved to be extremely accurate (1.0 mm) and easy to use indoors. Distance measurements were verified with tape measurements from 1 cm, 1 m, 10 m, and 100 m. Both units were exact in behavior and distances measured and tested beyond the manufacturer's limits.

Field Trial

The units were taken outdoors and tested the same as those tested indoors. Results were as good, though there was some variance in unit behavior beyond 50 m, which indicated that the aim at the target unit was more critical than when indoors. Because our forest plots were usually 30 m or less on a side or in diameter, these early trials indicated that the sonic devices might be useful in the field. A field crew, using two units, double-checked three field plots with field tape and sonic distance measures; in all instances, the field tape was an inconvenient and time-consuming process by comparison.

Field workers quickly abandoned the measuring tape in lieu of the sonic device, despite some minor drawbacks. For instance, under thick vegetative cover, the sonic waves and infrared beam were distorted or absorbed and caused the unit to register incorrect distances. Unit behavior was erratic under these conditions, but even the novice operator quickly learned how to adjust the angle to the target or remove the interfering leaf cover. Because our work kept us under forest cover, rain and wind did not affect the readings. During an open-marsh survey, however, we discovered that the wave transmission was apparently sensitive to windspeed and rain. We also found, while working in wetland environments, that the unit is not waterproof and may not function if wet. Overall, field sampling with the sonic device was more efficient and accurate than with a tape measure; we were able to move about the stand freely and were not having to constantly rethread the angle of a tape measure. It was also easier to keep up with the order of trees and thereby avoid the chance of not recording some trees.

Field Accuracy

Sample accuracy in the field was improved because the sonic unit records to the nearest millimeter. The ability to read most tape measures required an interpolation process by the field staff to achieve that degree of accuracy. Just holding the tape against the bark of a tree confounded the ability to read the exact distance. The sonic device was designed to measure from the butt end of the unit; that is, one placed the unit against the flat of the tree trunk and pressed a bar for measurement. Routinely, we checked our work by taking multiple measurements and assessing the unit's behavior or consistency in measuring individual trees. We found that the unit had great integrity and repeatability.

Battery life seemed long, although we did not record it. We advise bringing spare batteries to the field, however, because low batteries can affect unit capabilities. Also, the use of two or more units was possible on the same plot, unlike field tapes that are likely to become entangled. Multiple receivers can be used with a single transmitter or a single receiver used with multiple transmitters. Another advantage of this technology was that one person could measure a plot alone by mounting the signal transmitter unit on tripods at plot reference points. The sonic devices are small enough to fit comfortably in the average hand or shirt pocket and are thus less cumbersome than field tapes.

Sampling efficiency was estimated by comparing the measurement accuracy and elapsed time from start to finish using both methods for a set of plots. We found little difference in measurement error between methods, although results with the sonic device were slightly more consistent. About 50-70% less time was required with the sonic device to collect the same amount of data. Field workers appreciated the convenience, speed, and accuracy of using the sonic device. Routine calibration of the sonic device was conducted with each new plot by remeasuring about 5% of the trees with a tape. No degradation of sampling accuracy or dependability with the sonic devices was evident over a summer field season.

Summary

Electronic distance devices offer the means to speed field sampling and to ensure greater spatial resolution and accuracy. Field conditions, however, can be too windy or rainy and alter the function of these devices. The field application may also preclude the use of a sonic device if the distances involved are more than 50 m. For appropriate applications, however, such as forest inventory work in small plots, these sonic devices are useful, efficient, and accurate.

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